DOCUMENT RESUME

ED 162 264 CS 004 460

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TITLE Directionality in the Acquisition of Letter Sounds in Beginning Readers. Technical Report No. 46.
INSTITUTION Kamehameha Schools, Honolulu, Hawaii. Kamehameha Early Education Project.
PUB DATE [74]
NOTE 13p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Beginning Reading; *Learning Processes; Learning Theories; *Paired Associate Learning; *Phonics; Preschool Education; *Reading Instruction; *Reading Research; Vocabulary Development

ABSTRACT

In an investigation of the degree to which children learn associations in the direction opposite to the one in which they were taught, 20 preschool children were instructed in letter-sound correspondences in one of two ways. One group was presented with the letter symbol and asked to produce the sound, while the other group was presented with the letter sound and asked to point to the corresponding letter symbol in an array of letters. After the last acquisition trial, the children were given a reversal trial in which they were presented with the usual response and asked to produce the stimulus. It was found that performance on the reversal trial was significantly lower than on the last acquisition trial.
(Author/FL)

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ED162264

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Technical Reports

of

The Kamehameha Early Education Program

a research and development program established and funded by

The Kamehameha Schools/Bernice P. Bishop Estate

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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Technical Report #48

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The cooperation of the State of Hawaii Department of Education is gratefully acknowledged, as is the support and resources made available by the Sociobehavioral Research Group, MRRC, University of California, Los Angeles.

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Published by The Kamehameha Early Education Project, 1850 Makuakane Street, Honolulu, HI 96817

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## The Kamehameha Early Education Program

The Kamehameha Early Education Program (KEEP) is a research and development program of The Kamehameha Schools/Bernice P. Bishop Estate. The mission of KEEP is the development, demonstration, and dissemination of methods for improving the education of Hawaiian and Part-Hawaiian children. These activities are conducted at the Ka Na'i Pono Research and Demonstration School, and in public classrooms in cooperation with the State Department of Education. KEEP projects and activities involve many aspects of the educational process, including teacher training, curriculum development, and child motivation, language, and cognition. More detailed descriptions of KEEP's history and operations are presented in Technical Reports #1-4.

Technical Report #48

Directionality in the

Acquisition of Letter Sounds in Beginning Readers

Gisela E. Speidel

When taught reading by the phonic method, a child must learn to match a particular sound to a particular letter. A teacher may attempt to teach these sound-symbol correspondences in a variety of ways. For instance, she may hold up the letter symbol and ask the children to say the sound. In this case, the direction of the learned association is the same as that required in reading. Alternately, a teacher may teach these letter sounds by saying the sound and having the child choose the correct symbol or by saying a word and asking the children to identify the letter symbol with which the word begins. In these instances (which were actually observed in a kindergarten class), the associations are taught in the reverse direction from that which is required in reading.

We sought to answer the question of whether children who have been taught the symbol-sound associations in one direction (Stimulus-Response: St-R) would be able to reverse and produce the St when presented with the (Response-Stimulus: R-St). (See appendix for research literature regarding lower R-St than St-R learning in paired-associate learning.) Specifically, we investigated whether children who had been taught to respond to a letter symbol with the appropriate sound would be able to point to the symbol when hearing the sound, and vice versa (i.e. whether children who had been taught to respond to a letter sound by pointing to the appropriate symbol would be able to say the correct sound when shown the symbol).

## Method

### Subjects

The subjects were 20 preschool children between the ages of 43 and 60 months with a mean age of 52.9 months. The school drew children mainly from lower middle-class families and families receiving financial support from the state. Only children who could pronounce consonant sounds, and who knew no more than two of the six letter-sound combinations were included.

Ten children were each assigned at random to one of two learning conditions. In Condition A, the children were presented with the symbol and asked to supply the corrresponding sounds, while in Condition B, the Experimenter said the letter sound and the children had to select the appropriate symbol from an array of letters.

### Materials

The letters used were the six lower case letters f, j, k, r, s, and v. These letters were printed on white 4" x 8" white index cards. For Condition A, the letters were displayed singly. In Condition B, different arrays with all six letters jointed together in a row were used.

### Procedure

The children, instructed individually, were first given a study trial. E showed the child a letter and pronounced the sound to be paired with it. After a pause of five seconds, E presented the next letter in the same manner, until all six symbol-sound pairs had been presented.

For Condition A, E continued with the following instructions. "I'm going to show you a letter. You say the sound that goes with the letter." The child was given 10 seconds to respond. After a correct response, E said, "Yes, that is ___"; after an incorrect response, "No, that is ___"; and after no response "That is ___." If a child did not respond for two consecutive presentations,

E would prompt by saying, "You say the sound that goes with this letter."

For Condition B, E continued her instructions after the study trial as follows, "I'm going to say a sound. You put your finger on the letter that goes with the sound I say." If a child pointed to the correct letter, E would also point to that letter and say, "Yes, that's ___." If the child had pointed to an incorrect letter, E would point to the correct response, saying, "No, that's ___." Finally, if the child failed to respond within ten seconds, the teacher would point to the correct letter saying, "That's ___." The letters were arrayed differently in each presentation of the stimulus cards.

A trial consisted of one presentation of each of the six sound-symbol pairs to be learned. Training was conducted until a child had responded correctly on all six pairs for two consecutive trials or until he had received 32 trials, whichever came first. Training was given in four sessions of eight trials each. The four sessions all occurred in the same morning. At the beginning of each session, E repeated the instruction for each condition. After each session, each child was given three pieces of candy.

Immediately after the last training trial, a reversal trial was given in which the children were presented with the response they had learned and were requested to produce the stimulus. Specifically, children in Condition A were presented with the letter sounds, and asked to point to the letter symbols on an array containing the six letters with which the sound was paired. Children in Condition B, on the other hand, were shown the symbols individually and asked to produce the corresponding sounds.

The number of associations correct on each trial was recorded for each child.

## Results

The mean number of correct responses on the last learning trial (LT) and on the reversal trial (RT) for each training condition is shown in Figure 1 while the means and the standard deviations of number correct for each condition on those trials are contained in Table 1. The results were analyzed by

Table 1

Means & Standard Deviations of the Number of Associations Correct on the Last Training Trial and on the Reversal Trial

| Training Condition | Last Learning Trial | Reversal Trial |
|---|---|---|
| Condition A $\bar{X}$ | 3.80 | 2.40 |
| SD | 1.66 | 1.71 |
| Condition B $\bar{X}$ | 3.65 | .70 |
| SD | 1.84 | .67 |

means of a two factor mixed repeated measures ANOVA in which trials (LT or RT) constituted the within subject factor and training condition the between factor (see Table 2).

Fig. 1 The mean number of associations correct for each of the training conditions on the last learning trial (LT) and on the reversal trial (RT).

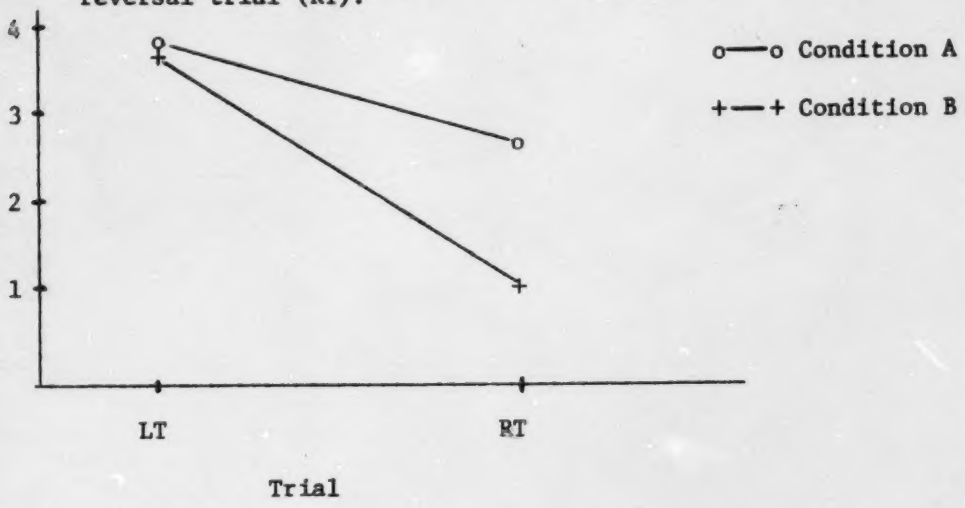


Table 2

Summary of the ANOVA on number of correct responses on the last acquisition trial & and the reversal trial

| SV | SS | df | MS | F |
|---|---|---|---|---|
| Total | 157.35 | 39 | | |
| Between S | 64.87 | 19 | | |
| $SS_A$ | 9.02 | 1 | 9.02 | 2.90 |
| $SS_{S/A}$ | 55.85 | 18 | 3.10 | |
| Within S | 92.50 | 20 | | |
| $SS_B$ | 46.22 | 1 | 46.22 | 20.46* |
| $SS_{AB}$ | 5.62 | 1 | 5.62 | |
| $SS_{SB/A}$ | 40.65 | 18 | 2.25 | 2.49 |

*$p < .01$

The main effect for training condition was not significant ($F=2.90$, $df=1/18$, $p < .20$). However, the trials effect was significant ($F=20.46$, $df=1/18$, $p < .01$) indicating that the R-St learning was significantly lower than the St-R learning for the two groups. Figure 1 suggests that the degree to which reversal of the St-R association was detrimental to performance differed for the two groups. On the R-St trial, Condition A was able to produce 63.2% of the learned St-R associations during the reversal trial while Condition B was able to produce only 19.2% of the learned St-R associations. However, the interaction effect between trials and training condition missed significance ($F=2.49$, $df=1/18$, $p < .20$).

## Discussion

The findings showed that for both training conditions, the performance on the reversal trial was poorer than on the final learning trial. The conclusion to be drawn from this is that the lower R-St learning than St-R learning, so well documented in laboratory paired associate learning with college students, is also found in regular classroom paired-associate tasks with young children.

Although the interaction effect between reversal and training condition was not significant, the difference in performance between the two conditions on the reversal trial is so large that it warrants some comment. Condition A's higher performance on the reversal trial might suggest that R-St is not equally impaired in all paired-associate training methods. Possibly, the extent to which R-St learning occurs depends upon specific aspects of learning tasks such as pointing or vocalizing the response during acquisition.

However, a more plausible interpretation of the difference in performance between the two groups on the reversal trials is that it is the result of

different methods of measurements used: namely, recognition and recall. Generally, measurement of amount learned by recognition results in a higher score than measurement by recall. The poorer reversal performance of Condition B can, therefore, be attributed to actual lower initial learning of the St-R association or to a more stringent method of measuring their reversal performance or both. That is, although the scores on the last two acquisition trials were identical between the two conditions, Condition B may have actually learned less because their learning was measured by recognition, while that of Condition A was measured by recall. Contrarily, on the reversal trials, the performance of Condition B was measured by the stringent recall method and that of Condition A by the lenient recognition method. Unfortunately, the nature of the specific task being investigated does not allow for equilibration of measurements of learning in the two groups.

The present findings have ramifications for classroom instructions.

Paired associate learning forms the basis of much, if not most classroom tasks: vocabulary, second language, reading acquisition, and learning to pair dates with historical information are a few examples. Teachers cannot continue to assume that learning to associate pairs in one direction (St-R) will automatically produce learning in the reverse direction (R-St). The teacher must become aware of the direction underlying paired associate tasks that she assigns to the children. If a bidirectionality of the associations is required later, she is advised to incorporate into her instructions tasks that require the children to learn the information in both directions. For example, in learning the letter symbol sound pairs, children will eventually be required to know them in both directions. Thus, a teacher should have such tasks as showing the child a letter and asking him what sound the letter makes, or showing words and asking the child to say the sound of the letter the word

begins with, as well as asking him to identify the symbol of a spoken sound or the letter with which the spoken word begins. Exposure to the letter symbol sound pairs is generally frequent in our society, so that eventually the children will learn the associations in both directions, regardless of method of instruction used. However, if a teacher analyzes the directionality of her tasks and bases her instructions on such an analysis, the children may learn more quickly.

## Appendix

In paired-associate learning, generally fewer response-stimulus (R-St) associations are acquired than stimulus-response (St-R) associations (see Kausler 1966 for a review). With nonsense syllables as the St, the amount of R-St learning appears to increase as St approaches meaningfulness (Jantz and Underwood, 1958; Cassem and Kausler, 1962). However, even with 100% meaningful St the amount of R-St learning rarely exceeds 50-60% of the St-R learning. The degree of associative asymmetry seems also to be dependent on stage of learning of the St-R associations (Wollen, Fox, & Lowry, 1970; Ney and Solso, 1974).

Underwood (1957) proposed that lower R-St learning occurred because the associations were acquired incidentally when learning the St-R associaitons. An alternative explanation of R-St learning has been presented by Asch and Ebenholtz (1962) who maintain that all associations are bidirectional. The seemingly lower R-St learning is explained as a result of the difference between the nominal St and the functional St.

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